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Theory of relativity without singularities

Contents

Abstract

I have to say it before: this is no contradiction to theory of relativity, this makes the theory more precise in a range, that could never been tested yet.

Singularities are avoidable in theory of relativity by consideration of mass variation. Mass varies not only by changing kinetic energy but also by changing of potential energy of the mass. This variation of the mass follows the relation $E = m\ c^2$. The mass will be more light, it decreases in the same way, as potential energy of this mass decreases. This will be very clearly by consideration of distances in the same range like Schwarzschild radius. Standstill mass is the potential energy against infinity.

The dissemination of the gravitational field varies near the mass also by considerations of mass variation. Also red shift varies near a heavy dense mass by consideration of mass variation. The event horizon disappears. Physics are possible inside of Schwarzschild radius.

1. Introduction

Singularities are in theory of special and general relativity at event horizon. Some physicists say, singularities are not really art of science of physics. Einstein has also not been enthusiastic by the singularities in theory of relativity, he was unhappy. Nobody can describe physically events at a singularity. And it is impossible to describe any physically event beyond event horizon. The event horizon contradicts the general assumption, that our science of physics can be used at every place in our universe. It is a not provable nonsensical statement, that our science of physics can be used at every place in our universe, if there are spaces in our universe, we cannot observe anyway. The event horizon is an unsatisfactory solution in theory of relativity.

I will show you, how theory of relativity works without singularities, without event horizon, without cosmic censor. It is not really sophisticated to avoid these singularities. I will show you the general solution of this problem, as simple as possible. It is not necessary to use rotations. This does not change basics, but it makes it much easier, to describe this solution.

I hope, many people are interested in this new sight on theory of relativity. Therefore I use only school mathematics and school physics (secondary school). It is not necessary to use the 4-dimensional space time (Minkowski space), I need only 3 geometric dimensions and the time to explain this disappearing of the event horizon. But I need calculus.

I have to explain something to numbering of the equations. The number of the equation is in brackets in front of the equation. (2.4) signifies, this is the fourth equation in the second chapter. It is a repetition of this equation, the equation was written in the text before, if the number is behind the equation.

2. Influence of potential energy to mass

Albert Einstein discovers in his theory of special relativity that mass of an object increases by kinetic energy (velocity). But mass of an object varies also by potential energy (energy of position, static energy). This will be demonstrated by using the law of conservation of energy (and mass) (constancy of energy and mass in a closed system). All singularities in theory of relativity disappear, if you consider this mass variation by potential energy also. I will demonstrate here, how it works.

Potential energy of two masses is the ability to generate energy from the position of the two masses together. This is possible only by force of gravitation. The classic (Newton) equation of gravitational force is :

$$F = \frac{G \cdot m_1 \cdot m_2}{r^2} \tag{2.1}$$

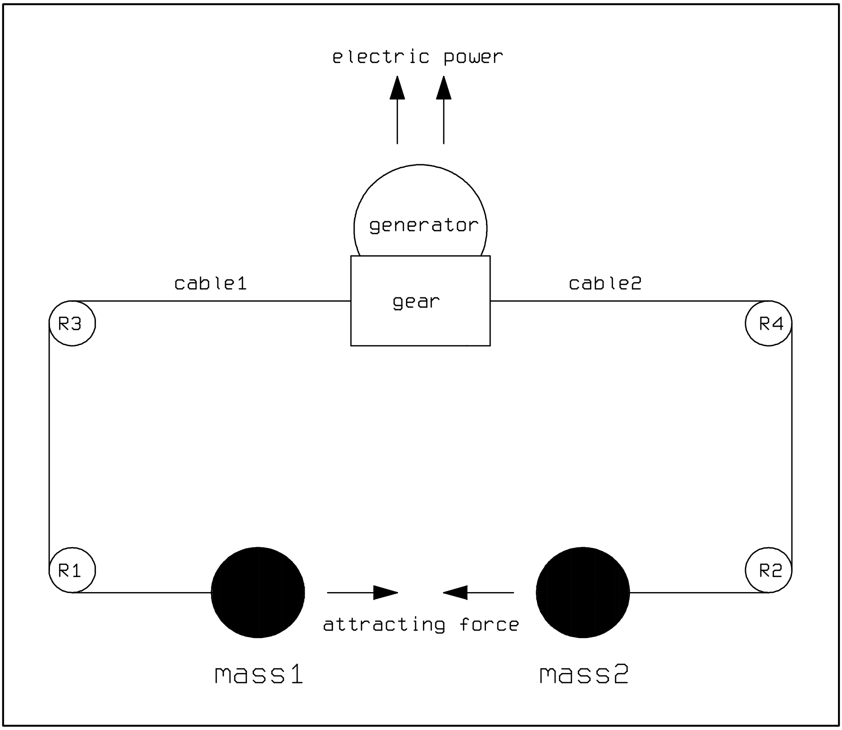
G is the gravitational constant in this equation, m_1 and m_2 are the two attracting masses mass1 and mass2, F is the force between the two attracting masses and r is the distance between the two attracting masses (their centers). The two masses mass1 and mass2 attract together conform to the equation (2.1).

Energy will be generated by gravitational force by approaching these two masses slowly together. The source of this energy is the gravitational field of the two masses, the potential energy (energy of position of the two masses together).

We have to make an experiment in our brain to investigate the mass variation by potential energy, an experiment only by our thoughts. There are some facts against a real experiment, for instance the stability of cables and mechanic construction, the disturbing mass of constructive elements like cables, pulleys, supporting mechanic elements and especially the giant quantity of force and converted energy. But this experiment in our thoughts is enough to determinate the mass variation and red shift by approaching masses.

We imagine in our thoughts, it is possible as shown in picture 1, to take two attracting masses mass1 and mass2 and connect them to two cables, lead this cables over the pulleys R1 to R4 to a gear, that drives an electric power generator. The generated electric power has to be removed to outside of the system. It can be used for unidirectional radiation of light into space. This converted potential energy has to be released to outside of the system for the investigation of the system.

The both masses mass1 and mass2 attract together conform to classic equation (2.1) of gravitational force. The approaching movement of the two masses mass1 and mass2 will be slowed down by the generator that converts the potential energy to electric power (energy). This electric energy has to be released. This released converted potential energy has to be subtracted from sum of energy of the system. The system will be lighter by dissipation of potential energy conform to the equation $E = m c^2$.



Picture 1 : Configuration of two masses. Their potential energy will be converted to electrical energy and removed from the system

The sum of all energy of the two masses is at beginning at infinite big distance r of the two masses mass1 and mass2 :

(2.2) $$E = m_1 \cdot c^2 + m_2 \cdot c^2$$

The two masses should be (for the moment) equal and we can write :

(2.3) $$m_1 = m_2 \qquad (= m)$$

The sum of all energy can be written :

(2.4) $$E = 2 \cdot m \cdot c^2$$

The two masses mass1 and mass2 will approach slowly together from a greater distance now. The released potential energy (energy of position) will be completely converted in the generator to electric energy and removed from the system. The released potential energy is :

(2.5) $$\Delta E = F \cdot \Delta r \qquad \text{(energy = force} \cdot \text{distance)}$$

F is the attracting force between the two masses, Δr is the variation of the distance between the two masses, and ΔE is the released energy, the variation of the potential energy. F in equation (2.5) has to be substituted by the right side of equation (2.1), the classic attraction force and you get :

(2.6) $$\Delta E = \frac{G \cdot m_1 \cdot m_2}{r^2} \cdot \Delta r$$

This is the decreasing of potential energy of the two masses at approaching together. This energy will be subtracted from both masses, half of energy from mass1 and the other half of energy from mass2. Therefore is :

(2.7) $$\Delta E = 2 \cdot \Delta m \cdot c^2$$

You can get the mass variation of the masses by rearranging of the equation (2.7) :

(2.8) $$\Delta m = \frac{\Delta E}{2 \cdot c^2} \qquad \text{(for each of the two masses !)}$$

You have to insert energy ΔE from equation (2.6) for decreasing energy by approaching masses into equation (2.8) for mass variation and you get :

(2.9) $$\Delta m = \frac{G \cdot m_1 \cdot m_2}{2 \cdot c^2 \cdot r^2} \cdot \Delta r$$

Each of the two masses will be lighter (smaller) by Δm after approaching a distance Δr. You have to calculate in the next step with m_1-Δm and m_2-Δm. Both masses m_1 and m_2 will be lighter by releasing potential energy. This equation (2.9) is a basic equation of this description. It is necessary to integrate this equation (2.9) to get the mass m depending on distance r. These integrals all have been tested (proved) by numeric integration.

The general solution of this integral is not so easy, because both masses m_1 and m_2 are functions of r. But Δm is identical for both masses m_1 and m_2. Every time m_1 should be the greater or equal than m_2 in our equation. It is every time :

(2.10) $$m_1 \geq m_2$$

At least m_{END} will remain after approaching of m_1 and m_2 :

(2.11) $$m_{END} = m_1 - m_2$$

Therefore the maximum released energy by approaching m_1 and m_2 is the difference of equation (2.2) and equation (2.11) :

(2.12) $$E_{MAX} = ((m_1 + m_2) - (m_1 - m_2)) \cdot c^2$$

You will get, if you solute inner brackets :

(2.13) $$E_{MAX} = (m_1 + m_2 - m_1 + m_2) \cdot c^2$$

(2.14) $$E_{MAX} = 2 \cdot m_2 \cdot c^2 = 2 \cdot m_S \cdot c^2$$

It is possible to release double of the smaller mass m_S in energy by approaching two point-like masses to the same point, but not more. It is impossible in reality because of the finite density of the masses.

I will show the integration of equation (2.9) at two special cases : first $m_1 = m_2$ and second m_1 is very much more big than m_2.

2.1. case $m_1 = m_2$ two equal masses attract themselves

The equation (2.9) can be written if $m_1 = m_2$ (= m) is :

(2.15) $$\Delta m = \frac{G \cdot m^2}{2 \cdot c^2 \cdot r^2} \cdot \Delta r$$

We need m^2 on the left side of the equation. The rearranged equation is:

(2.16) $$\frac{1}{m^2} \cdot \Delta m = \frac{G}{2 \cdot c^2 \cdot r^2} \cdot \Delta r$$

We have to write this equation (2.16) as integrals and get :

(2.17) $$\int \frac{1}{m^2} \, dm = \int \frac{G}{2 \cdot c^2 \cdot r^2} \, dr$$

The solution of this integrals is :

(2.18) $$-\frac{1}{m} = -\frac{G}{2 \cdot c^2 \cdot r} - k$$

k is the constant of integration and not without a dimension. k has the dimension kg^{-1} and was selected negative. It is necessary to multiply both sides of equation (2.18) with $-(m \cdot r)$ to get m and r above the fraction bar. We get :

(2.19) $$r = \frac{G \cdot m}{2 \cdot c^2} + k \cdot m \cdot r$$

We exclude m from the right term and we get :

(2.20) $$r = \left(\frac{G}{2 \cdot c^2} + k \cdot r \right) \cdot m$$

We reorganize equation (2.20) to m (division by the term in the brackets and exchange left and right) and we get :

(2.21) $$m = \frac{r}{\frac{G}{2 \cdot c^2} + k \cdot r}$$

We define k as a reasonable value :

(2.22) $$k = \frac{1}{m_0}$$

m_0 is the mass m_1 or m_2 at infinite distance r. We substitute k in equation (2.21) and get :

(2.23) $$m = \frac{r}{\frac{G}{2 \cdot c^2} + \frac{r}{m_0}}$$

This equation (2.23) describes the influence of the distance r to two equal masses m_1 and m_2 at approaching themselves. There is at infinite distance r :

(2.24) $$m = m_0$$

and there is at r near zero :

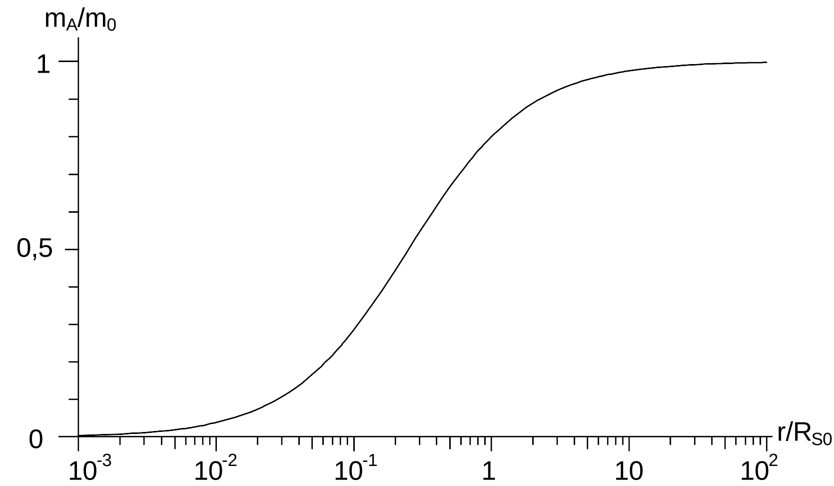
(2.25) $$m = \frac{2 \cdot c^2}{G} \cdot r$$

The dependence of some values from our thought experiment on distance r is shown in the pictures 2 to 8. R_{S0} is in all pictures the Schwarzschild radius of the mass m_1 or m_2 at infinite distance r. The distance is shown as the quotient from actual distance r to R_{S0}. Schwarzschild radius R_{S0} is defined as :

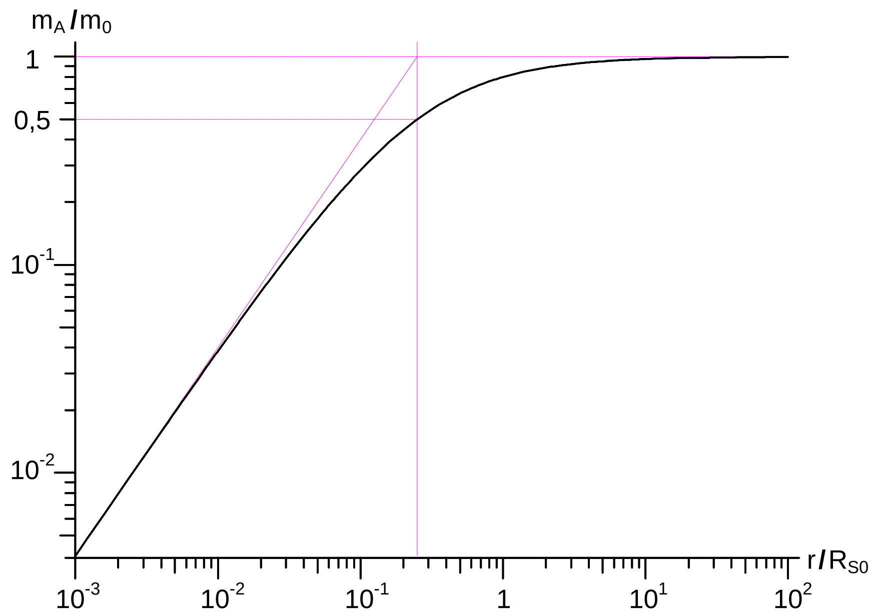
(2.26) $$R_{S0} = \frac{2 \cdot G \cdot m_0}{c^2}$$

Thereby standardized pictures will be generated. The pictures illustrate very clearly, characteristics of gravitational field. Mass, gravitational force or gravitational acceleration change characteristics at Schwarzschild radius in our arrangement of our thought experiment.

The dependence of mass on distance r is shown in pictures 2 and 3. The mass is shown as a quotient from actual mass m_A to original mass at infinite distance m_0. This will generate standardized pictures also. The smallest distance and also the smallest mass is shown left down in the pictures 2 and 3. You will move from right up to left down in the picture, if you approach the two masses of our thought experiment. The masses mass1 and mass2 will be less only by approaching themselves and releasing potential energy. Mass is shown in picture 2 in a linear scale and in picture 3 in a logarithmic scale. You can see, curve of mass is at the right side constant and



Picture 2 : dependence of mass m_A/m_0 on distance r/R_{S0}. m_A is the actual mass, m_0 is the mass in infinitive distance, r is the distance of the two masses and R_{S0} is the Schwarzschild radius of the mass m_0. mass has a linear scale.



Picture 3 : dependence of mass m_A/m_0 on distance r/R_{S0}. m_A is the actual mass, m_0 is the mass in infinitive distance, r is the distance of the two masses and R_{S0} is the Schwarzschild radius of the mass m_0. mass has a logarithmic scale.

changes around Schwarzschild radius downward. The curve approximates (in double logarithmic scales of picture 3) the straight line :

$$m = \frac{2 \cdot c^2}{G} \cdot r \qquad (2.25)$$

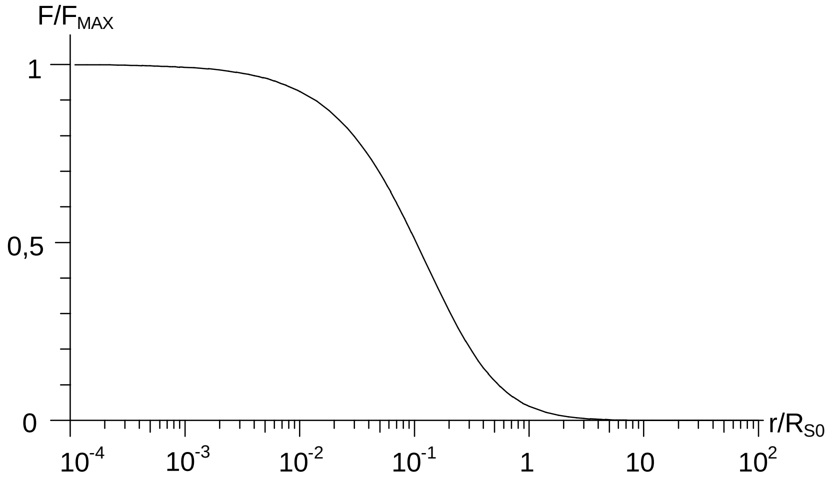
This straight line will never be reached, but it will be approximated to infinite small distances. Every time r is a little bit bigger and m is a little bit smaller than the straight line.

The dependence of the force between the two masses from distance r is shown in pictures 4 and 5. These pictures are also standardized. Force is shown in a linear scale in picture 4 and in a logarithmic scale in picture 5. Force curves from right down to the force limit left up. It is surprising, but the force between two masses is limited. Force is proportional to $1/r^2$ if distance between masses is above Schwarzschild radius. And force approximates the force limit of $4.8410 \cdot 10^{44}$ N, if distance r is lower than Schwarzschild radius. You can calculate this force limit with the equation :

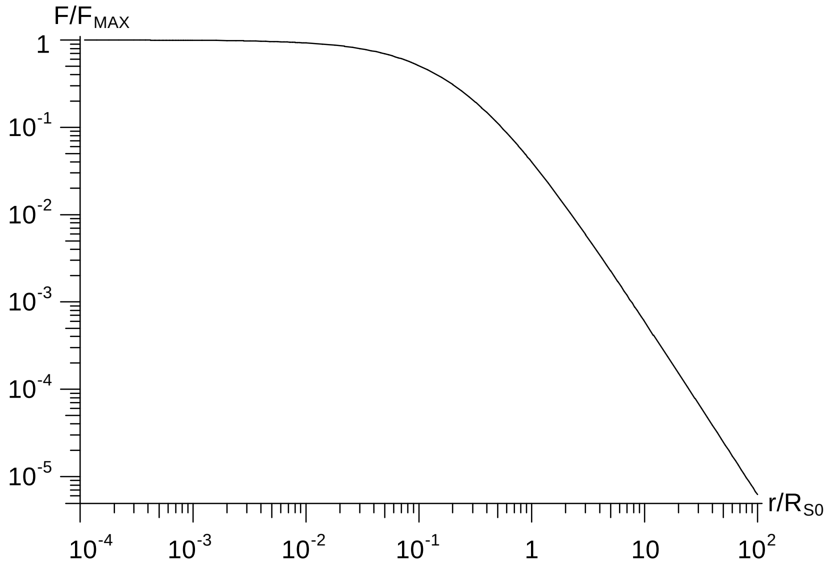
$$(2.27) \qquad F_{MAX} = \frac{4 \cdot c^4}{G} = 4.8410 \cdot 10^{44}\ N$$

Force will be approximated to 10^{-3} of force limit by approaching to $10^{-4}\ R_{S0}$ distance of the masses. A mass of $6,7 \cdot 10^{30}$ kg (a bit more then 3 sun masses) has a Schwarzschild radius of 10 km. Two masses of each $6,7 \cdot 10^{30}$ kg have an attracting force of $4,84 \cdot 10^{44}$ N, if it would be possible to approach their mass centers to a distance of 1 meter. Each mass has decreased to less than 1/1000 of original mass in this distance.

The description above is real for approaching of every pair of two equal masses. If somebody approaches two masses of 1 kg with a Schwarzschild radius of each $1,5 \cdot 10^{-27}$ m, this two masses will attract themselves in a distance of 10^{-31} m with a force of $4,84 \cdot 10^{44}$ N. These two masses will decrease to a mass of less than 1g each by approaching to the distance of 10^{-31} m. Also the two first descripted masses of each $6,7 \cdot 10^{30}$ kg would have an attracting force of $4,8410 \cdot 10^{44}$ N and a weight of less than 1g each by approaching them to a distance of 10^{-31} m. Approaching to such small distances is impossible because of the finite maximum density of mass.



Picture 4 : dependence of attracting force on distance. F_{MAX} is the maximum force of $4.84 \cdot 10^{44}$ N, R_{S0} is the Schwarzschild radius



Picture 5 : dependence of attracting force on distance. F_{MAX} is the maximum force of $4.84 \cdot 10^{44}$N, R_{S0} is the Schwarzschild radius of original mass. Force is shown in logarithmic scale.

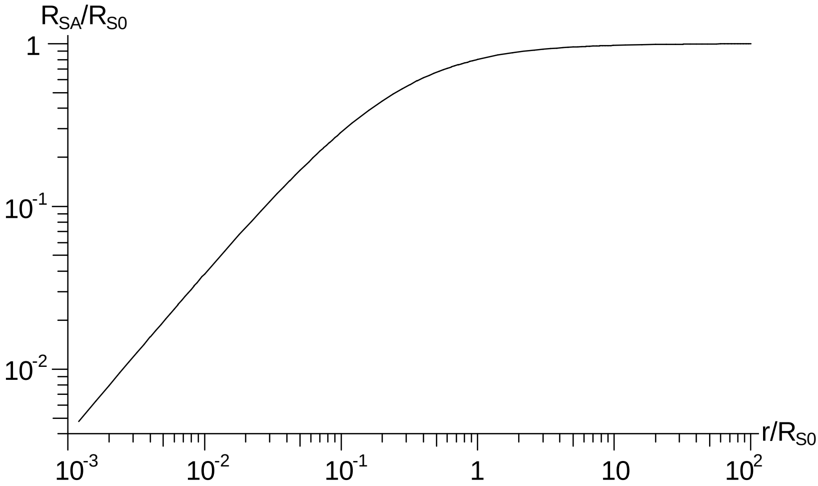
The mass of the two masses mass1 and mass2 decreases by approaching of two masses and releasing potential energy. But not only the masses themselves decrease, also the actual Schwarzschild radius R_{SA} will decrease by approaching masses. In picture 6 is shown the ratio of actual Schwarzschild radius R_{SA} to the original Schwarzschild radius R_{S0} depending from distance r/R_{S0}. Picture 6 looks like picture 3 because of Schwarzschild radius R_{SA} is by equation (2.26) direct proportional to actual mass.

It is clear, Schwarzschild radius of our two masses decreases also, if masses decrease by approaching themselves. Picture 7 shows the ratio from distance r to actual Schwarzschild radius R_{SA} depending on normalized distance r/R_{S0}. It is surprising, but it is impossible to approach two equal masses to less than ¼ of actual Schwarzschild radius R_{SA}. If somebody will continue approaching of the two masses, mass and actual Schwarzschild radius R_{SA} will decrease in the same way like distance caused by decreasing of mass. The ratio r/R_{SA} will approximate to ¼ and will be more and more constant at reduction of distances clear below Schwarzschild radius.

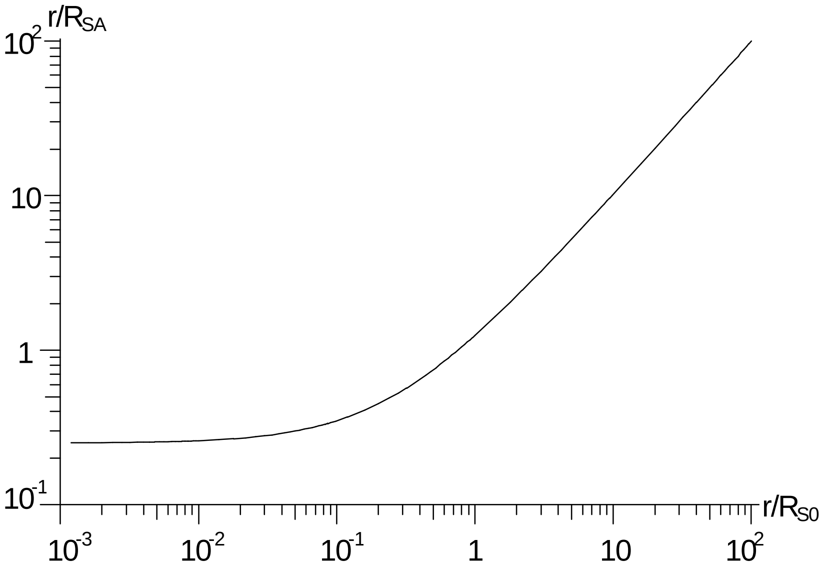
It will be noticeable an unpleasant characteristic of this gravitational acceleration by consideration of the two masses: gravitational acceleration is infinite at the place of a point-like mass. But point-like masses are impossible. Every mass has a volume because of the maximum possible density of about 10^{18}kg/m^3. It is impossible to approach the two masses on a distance below their own size of mass itself. Therefore gravitational acceleration is limited, infinite gravitational acceleration is impossible. But there is another point of view : if approaching of two point-like masses will be continued to the end, and the point of infinity of acceleration is reached, there is no mass remaining to be accelerated. There is no mass what can be accelerated in this point.

Acceleration in m/s^2 of two equal masses of $6.7329 \cdot 10^{30}$ kg (R_{S0} is exactly 10^4 m or 10 km) in dependence to distance r in m is displayed in picture 8.

You can notice, gravitational acceleration is increasing unlimited. If you will look on picture 8. There is no zero point in double logarithmic



Picture 6 : dependence of ratio R_{SA}/R_{S0} to normalized distance r/R_{S0}

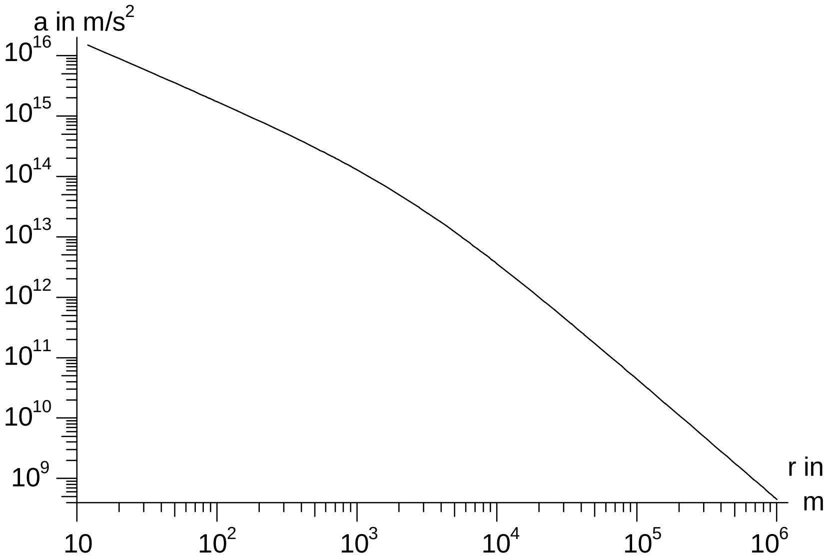


Picture 7 : dependence of the ratio r/R_{SA} to normalized distance r/R_{S0}

diagrams, you can continue picture 8 unlimited to the left. But you can see also, the rising of acceleration clearly decreases at Schwarzschild radius. This reduction of rising of acceleration is caused on decreasing of the approaching masses by releasing potential energy.

It is a question of maximum density, how near you can go to the infinity. It is impossible to approach two masses below their own size. There are another conditions in the atomic range : what distance is necessary for interaction of two masses. Are there objects, they could interact in a distance of 10^{-31} m and they have a weight of about 1g ? I do not know such objects !

It is shown in picture 5, force between every pair of equal masses is limited at unlimited approaching themselves. This force goes to the limit of $4{,}84 \cdot 10^{44}$ N inside of Schwarzschild radius. The acceleration



Picture 8 : acceleration in m/s^2 of the two equal masses mass1 and mass2 together, if the somebody will let the two masses free falling at moment of start of the fall in dependence of the distance r of the two masses in m. Mass is at beginning $6.7329 \cdot 10^{30}$ kg, R_{S0} is exakt 10^4 m (10 km). Every free fall is relativistic !

will increase unlimited by a constant maximum force on infinite decreasing masses mass1 and mass2. This increasing of the acceleration is limited only by the volume of the masses, by their geometrical size. It is impossible to approach two masses less then their geometrical size. Therefore acceleration between two real masses is ever limited and depending on density of the masses.

As more the two masses will be approached together as more energy will be released and as more light the system of the two masses will weight. This effect is known from physics of atoms. The nucleus of an atom weights less than the sum of neutrons and protons of the atom. The mass variation is very small at distances big compared to Schwarzschild radius, and it may be impossible to measure this minimal mass variation. But this changes if you reach small distances like Schwarzschild radius. Mass variation will be essential at distances like or below Schwarzschild radius. 1/5 of mass is converted to energy in our brain experiment system by approaching the two masses to Schwarzschild radius. Our brain experiment system has lost 1/5 of its mass at this point. It is 1/5 lighter than at start of approaching, 1/5 of all energy of the system has been released by approaching the two masses to Schwarzschild radius.

As more, as it is possible to reduce the distance between the two masses, as more potential energy will be released and as more light will be this system of the two masses. All energy of the two masses $2mc^2$ will be released, if it would be possible to move two point-like masses mass1 and mass2 to the same point. No energy and of course no mass will remain, if the two masses will be moved to the same point. The system of the two masses does no longer exist. There is no singularity of force or of energy by approaching two point-like masses in our experiment in brain. There are no point-like masses in reality, every mass has a volume and a size. It is not possible to approach two masses below the size of the masses itself. Therefore mass approaching cannot release all energy of the two masses. Some mass will remain. But there will be released more energy if the masses are bigger and if the density is more high and if the distance of the masses is smaller.

I would have a look on the electrical analogon to the mass, the electric charge, to show the situation more clearly. The situation is much more clear and plausive if you consider two opposite charges, which attract themselves. Two charges attract themselves if you approach a positive charge +Q to an equal valued negative charge -Q. Energy will be released, by the attracting force at approaching this two charges. The energy of the charges will decrease by the released potential energy of the charges together. It is plausive and according to our experience, if you will put the two point-like charges +Q and -Q to the same place, there is no charge and no energy remaining. All energy of the system of the two charges has been released. It is similar in our system of the two masses but it contradicts to our experience. You can see the reason of this discrepancy if you have a look on the used masses and distances. Nobody has ever seen less than 2kg on the scale, if you put two weights of each 1kg together on the scale. All our scales show exactly 2kg. The reason will be clear if you look on necessary distances to get a measurable effect. This necessary distance is about 10^{-26} m to get effects with two weights of each 1kg. This is impossible. A cube with 1kg mass has a minimal size of about 4cm on the earth. The geometrical size of a mass on the earth is about 25 decades to big to get effects of this kind. Approaching to such small distances is impossible on earth and therefore you cannot get any effect on earth. But you can see very clearly effects at approaching to neutron stars or to supermassive galactic nuclei.

2.2. case $m_1 >> m_2$ a big mass attracts a small mass (m_1 = constant)

We made all investigations yet by approaching of two equal masses. Now we have to investigate, what happens if m_1 is very much bigger then m_2 .I will look on electrical analogon again, to explain, what happens when the two different masses approach together. There is a law in the science of electricity : a charge cannot disappear. You can generate charges by separation a positive charge from a negative charge, and you can discharge if you put a negative charge to a positive charge. The sum of the charges will be constant.

Separation of charges needs energy and discharging releases energy. You will get a charge Q_3 of 9 As, if you will approach a first charge Q_1 of 10 As and a second charge Q_2 of -1 As to the same place. 2 As charge will be converted to released energy by approaching, 1 As derives from electrical field of Q_1 and the other 1 As derives from electrical field of Q_2. It is similar when you will approach a first point-like mass m_1 of 10 kg and a second point-like mass m_2 of 1 kg to the same place if you will not look on geometrical impossibility. You will get by approaching a remaining mass m_3 of 9 kg and 2 kg energy ($1{,}8 \cdot 10^{17}$ Ws). 1 kg energy is released from gravitational field of m_1 and the other 1 kg energy is released from gravitational Field of m_2. A mass m1 - m2 is remaining at least if $m_1 \geq m_2$. The maximum released energy is:

$$E_{MAX} = 2 \cdot m_2 \cdot c^2 = 2 \cdot m_S \cdot c^2 \qquad (2.14)$$

It is possible to calculate the dependence of very small mass m_2 on the distance to the very big mass m_1 by slowly approaching both masses and disappearing the released potential energy from the system of the two masses. It is our experiment in the brain with two different masses. And the released potential energy is converted to electric power and released from the system. We have to use equation (2.9). We rename m_1 to m_B (very big mass) and m_2 to m_S (very small mass). We have to divide both sides of equation with m_S and we get:

$$(2.28) \qquad \frac{1}{m_S} \cdot \Delta m = \frac{G \cdot m_B}{2 \cdot c^2 \cdot r^2} \cdot \Delta r$$

m_B and m_S will vary in the same way, Δm is equal for both of them. m_B is nearly constant if m_B is very much bigger than m_S. m_B does not really change, while m_S seems to disappear. We can use m_B as a constant in our equation. The energy will be released to outside of the system according to our experiment in the brain.

Equation (2.28) has to been written as integrals :

$$(2.29) \qquad \int \frac{1}{m_S}\, dm = \int \frac{G \cdot m_B}{2 \cdot c^2 \cdot r^2}\, dr$$

The solutions of this integrals are for m_B = constant :

(2.30) $$\ln(m_S) = -\frac{G \cdot m_B}{2 \cdot c^2 \cdot r} + k$$

k is constant of integration. You have to put both sides of the equation (2.30) into the exponent to the base e, the base of the natural logarithm, to get m_S separate on the left side of equation (2.30). You will get :

(2.31) $$m_S = e^{\left(-\frac{G \cdot m_B}{2 \cdot c^2 \cdot r} + k\right)}$$

The expression e^k is another constant k_2, and will be excluded from the brackets in the exponent by this way. You will get :

(2.32) $$m_S = k_2 \cdot e^{-\frac{G \cdot m_B}{2 \cdot c^2 \cdot r}}$$

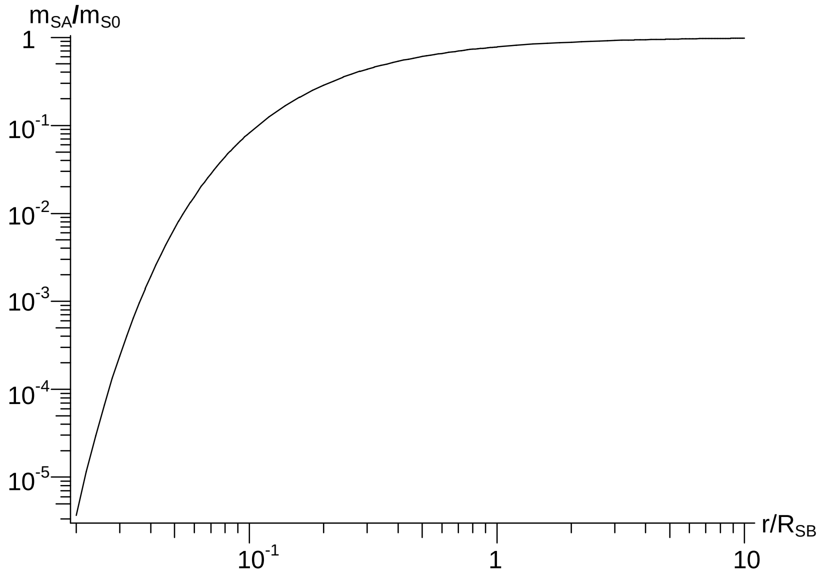
You have to substitute k_2 with a reasonable value. A reasonable value for k_2 is m_{S0}. m_{S0} is the small mass in infinite distance to the big mass m_B. You will get :

(2.33) $$m_S = m_{S0} \cdot e^{-\frac{G \cdot m_B}{2 \cdot c^2 \cdot r}} = m_{S0} \cdot e^{-\frac{R_{SB}}{4 \cdot r}}$$

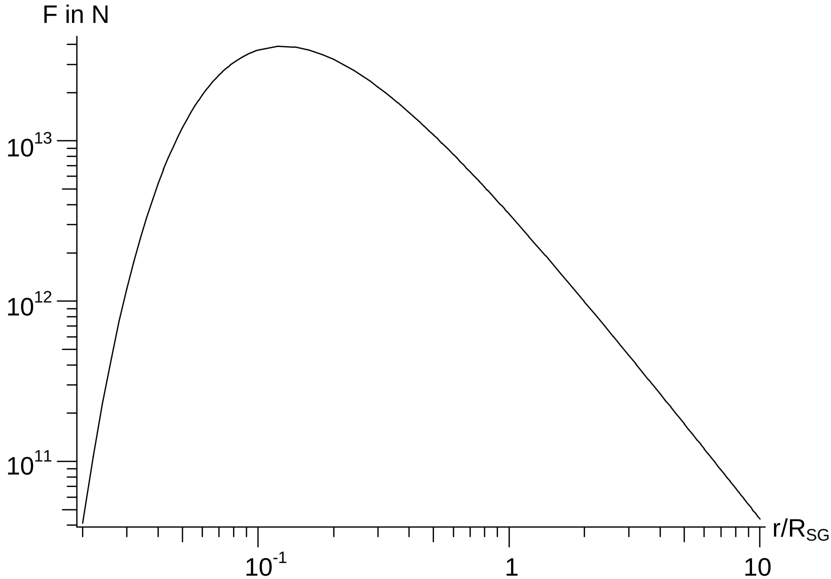
This equation (2.33) describes the dependence of a very small mass m_S on the distance r to a very big mass m_B. The result is for very great distances r mass $m_S = m_{S0}$ and the result is for distances r near zero a mass m_S near zero.

The dependence of the small mass and of the force between the small and the big mass on the distance to the big mass is shown in pictures 9 and 10. There has been 30 decades mass difference in the calculation. Small mass m_S has been 1 kg and big mass m_B has been $6.7329 \cdot 10^{30}$ kg (R_{SB} = 10 km) in calculation. The big mass m_B varies only unmeasurable (less than 10^{-30}), while small mass m_S seems to disappear depending on the distance to the big mass. The dependence of the small mass m_S on distance r to big mass is shown in picture 9. You can see, small mass disappears in the center, at the big point-like mass.

Picture 10 shows the dependence of the force F between the small mass of 1kg and the big mass of $6.7329 \cdot 10^{30}$ kg on the distance r between the masses. You can see, force between the two masses will rise to a maximum at 0.12 R_{SB} and then descent to zero in the



Picture 9 : dependence of normalized small mass m_{SA}/m_{S0} from normalized distance r/R_{SB} of the two masses



Picture 10: dependence of the force F in N from the distance of a small mass m_s of 1kg to a big mass m_B of $6.7329 \cdot 10^{30}$ kg (R_{SB}=10km)

center of the point-like big mass. No singularity in force will be created by an unlimited approaching of a small mass to a big mass, also not with point-like masses.

It will be clear, releasable potential energy is depending on the mass and the density of the two approaching masses. It is also clear; no singularities will be created by masses or forces in a gravitational field, or by charges or forces in an electric field. Releasing of energy is limited every time, also at using of point-like masses or charges. There is no violation of the law of conservation of energy (constancy of energy and mass in a closed system) by approaching of point-like masses or charges.

The own energy of a mass mc^2 you can see as potential energy to the infinity. You can release this energy with point-like masses theoretical complete (entire). You can release a certain part of this energy with real extreme dense and heavy masses, but not more ! Also not by the equations for gravitational or electric field ! Gravitational or electric potential is always limited !

The approaching of two masses together is limited by the maximum known density of about 10^{18} kg/m^3. A sphere with a diameter of $3{\cdot}10^{-27}$ m has a volume of about 10^{-80} m^3. You cannot put a mass of 1 kg into a volume of 10^{-80} m^3. Matter with a density of 10^{80} kg/m^3 does not exist. Therefore it is impossible to approach two masses of 1 kg to a distance of 10^{-27} m together.

The giant neutron star in the center of a galaxy may have a mass up to 10^{40} kg. A mass of 10^{40} kg has a Schwarzschild radius of $1.5{\cdot}10^{13}$ m. This sphere with this mass and a density of 10^{18} kg/m^3 has a radius of $1.3{\cdot}10^{7}$ m. It is possible to approach a mass to this giant neutron star to a distance of about 10^{-6} Schwarzschild radius of the giant neutron star. Giant quantities of energy will be released by this approaching.

It is possible to calculate the process of approaching two charges on the same way like calculation of approaching two masses. Attracting force is between two point-like charges :

(2.34) $$F = -\frac{Q_1 \cdot Q_2}{4 \cdot \pi \cdot \varepsilon \cdot r^2}$$

F is the force between the two charges, Q_1 and Q_2 are the two charges, and ε is the dielectricity constant (permittivity) (a constant of proportionality). Charges may be positive or negative. You will get a positive attracting force with different signed charges and a negative pushing force with equal signed charges. We will look only on the different signed charges, because only with different signed charges with an attracting force you can release potential energy by approaching these charges. The released energy is converted from electric field of the two charges. The two different signed charges discharge by approaching themselves. The law of conservation of energy works also in this system of two charges. You cannot get more energy than inherent energy is in the system of the two charges.

A very interesting consequence is, a mass will be heavier not only by acceleration (theory of special relativity), but also by lifting from big mass (theory of general relativity). Mass will be varied not only by kinetic energy but also by potential energy. The mass absorbs potential energy by lifting from a big mass and therefore the mass will be heavier.

For instance the two space probes pioneer 10 and 11 had been heavier by a factor of $5 \cdot 10^{-9}$ since their start from the earth by leaving the solar system. Pioneer space probes has weighed at start 250 kg and it became heavier about $1.2 \cdot 10^{-6}$ kg (1.2 mg). Pioneer space probes lost 28kg propellant and you cannot measure this very small additional 1.2 mg mass. This calculation starts at $1.5 \cdot 10^{8}$ km distance to the sun (orbit of the earth around the sun, 1 AE) and ends at $1{,}215 \cdot 10^{10}$ km (81 AE, last data from pioneer 10). Mass variation by variation of speed has not been calculated. Only increasing of potential energy of pioneer space probe to sun has been calculated. The little bit more heavy mass has the same kinetic energy like the original mass, and therefore the little bit more heavy mass slows down a little bit. The little bit slowed down mass has a little bit less centrifugal force, and a little bit more attraction force to the sun. Both effects cause a trajectory a bit more near to the sun and a bit more slowly. May be both effects contribute to the pioneer anomaly.

This effect is real also at earth satellites, but it is clear less. A satellite weighs on earth surface 1000 kg, and it weighs in a synchronous orbit in a height of 36000 km about $3 \cdot 10^{-7}$ kg (0,3mg) more by potential energy. It is impossible to detect such small mass differences. You can detect most minimal unexpected accelerations at the flight of the pioneer space probes; only because of they are leaving the gravitational field of the sun without propulsion for decades of years. Very small unexpected errors are integrating to measurable values on very long time. Opinion of the experts is indeed today, pioneer anomaly is a thermal effect.

A similar effect will be, if a mass will shrink very much and the released potential energy will be radiated to outside (thermal or light radiation).

The usage of the equations of gravitational or electric field generate at correct application no singularities ! Event horizons do not exist. Mass varies by variation of kinetic or potential energy.

3. Red shift near a mass

A photon (light particle) has the same behaviour in the gravitational field like any other small mass at approaching to a big mass. An observer can see that the photon loses energy. The Energy of the photon is decreasing at approaching to the mass. The energy of the photon is :

(3.1) $$E = h \cdot f$$

E is the energy of the photon, h is Planck's action quantum (Planck's constant) and f is the frequency of the light wave. Mass of the photon is :

(3.2) $$m = \frac{E}{c^2} = \frac{h}{c^2} \cdot f$$

(3.3) $$f = \frac{c^2}{h} \cdot m$$

You can see, mass of a photon is direct proportional to frequency of the photon. Frequency changes if energy of the photon changes. Red shift is defined as :

(3.4) $$z = \frac{\lambda_O}{\lambda_S} - 1 = \frac{f_S}{f_O} - 1$$

z is red shift, f_S is frequency of light source, f_O is frequency of light at observer, λ_S is wavelength at light source and λ_O is wavelength of light at observer. Entire energy changing is double of mass variation of a small mass at approaching to a big mass. Therefore red shift of a photon is :

(3.5) $$z = 2 \cdot \left(\frac{m_{S0}}{m_S} - 1 \right)$$

You have to put equation (2.33) for m_S into equation (3.5), cancel m_{S0} and you will get :

(3.6) $$z = 2 \cdot \left(e^{\frac{G \cdot m}{2 \cdot c^2 \cdot r}} - 1 \right) = 2 \cdot \left(e^{\frac{R_S}{4 \cdot r}} - 1 \right)$$

This equation (3.6) describes the dependence of red shift z on the distance r to the mass m. Attentive readers notice, this is not the classic equation for red shift at a mass. The classic wrong equation for red shift at a mass is :

(3.7) $$z = \frac{1}{\sqrt{1 - \frac{2 \cdot G \cdot m}{c^2 \cdot r}}} - 1 = \frac{1}{\sqrt{1 - \frac{R_S}{r}}} - 1$$

This classic equation cannot been calculated with $r = R_S$ (division by 0) and with $r < R_S$ (square root from negative value). z is defined only for values $r > R_S$.

You can see a diagram of this dependence of red shift z on distance r in pictures 11 and 12. A diagram of equation (3.6) is shown in picture 11. You can notice, red shift is infinite only in the center of a point-like mass. Point-like masses do not exist, every mass has a volume. And therefore red shift is ever limited at a real mass with limited density. May be the red shift z is giant at the neutron star in the center of a galaxy, but it is not infinite.

A diagram of equation (3.6) is also shown in picture 12, it is signed with N (new curve). Additional a diagram of equation (3.7) is shown, it is signed with C (classic wrong curve). Schwarzschild radius is marked with a pink line. You can see, classic curve is at Schwarzschild radius infinite and below Schwarzschild radius undefinable.

There is no singularity at Schwarzschild radius if you will use mass variation of a small mass to calculate red shift at a big mass. r=0 is impossible to calculate, there is a zero below the fraction bar in the exponent of the e-function in equation (3.6). r=0 is impossible for a real mass because you cannot go more near to a mass than its own size.

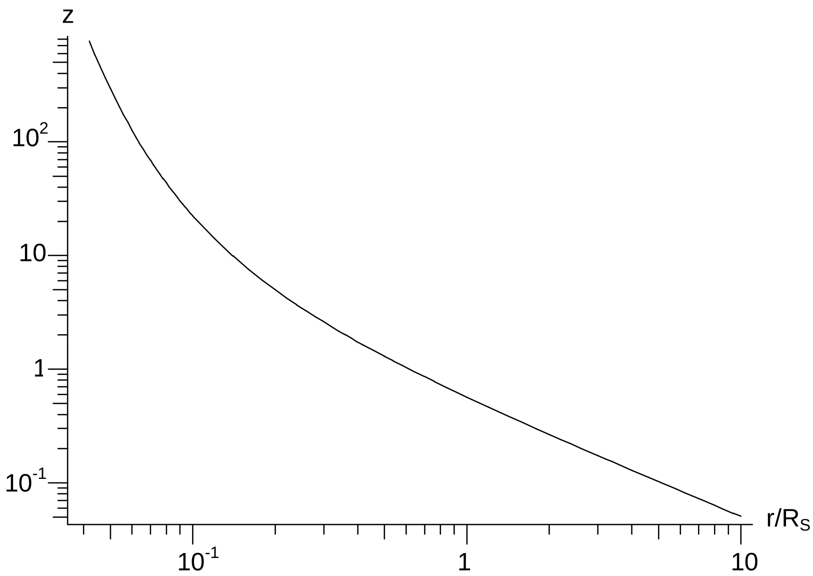
You can see in picture 12, both curves N and C approximate above $r = 10\ R_S$ the straight line :

(3.8) $$z = \frac{G \cdot m}{c^2 \cdot r} = \frac{R_S}{2 \cdot r}$$

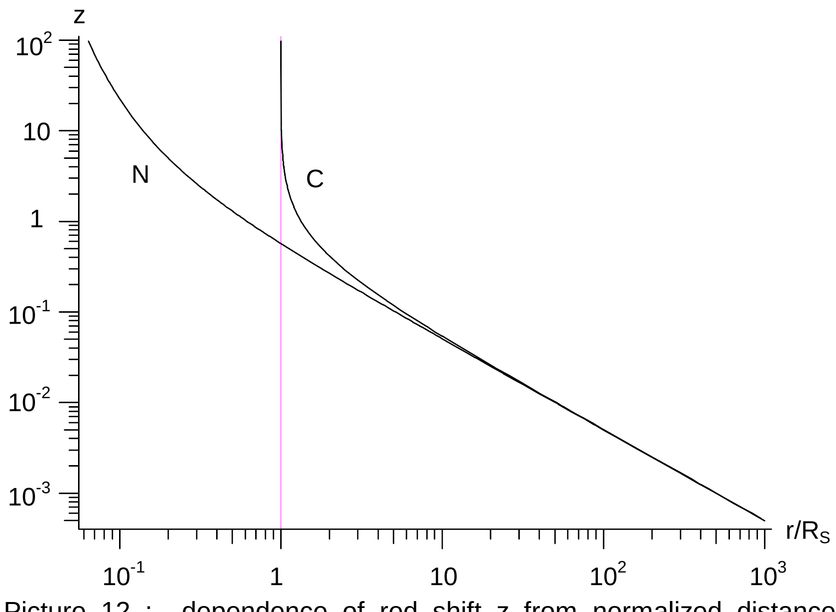
You can see differences between the two curves only below $r = 10\ R_S$.

This consideration shows clearly, there is no event horizon and there are also no black holes. Every body, what has a temperature, emits radiation. Also so called “black holes“ emit electromagnetic waves (light, heat). This radiation is more or less red shifted. Red shift is giant high at super heavy galactic nuclei; therefore we can see them only as black objects. But Einstein’s theory of relativity works without singularities. Also red shift has no singularity.

It is clear, releasable potential energy is depending on mass and density of both approaching masses. It is also clear, there are no singularities caused by masses or electric charges, independent on real density of the mass or charge. Releasing of energy is limited every time, also with theoretic point-like masses or charges. Law of conservation of energy (and mass) is real every time, it is never violated. The inherent energy of a mass mc^2 is the potential energy of this mass against infinity. This energy may be released theoretically complete with point like masses. Only a certain part of this energy will be released with real very heavy and dense masses but not all. Even



Picture 11 : dependence of red shift z from normalized distance r/R_S to the mass



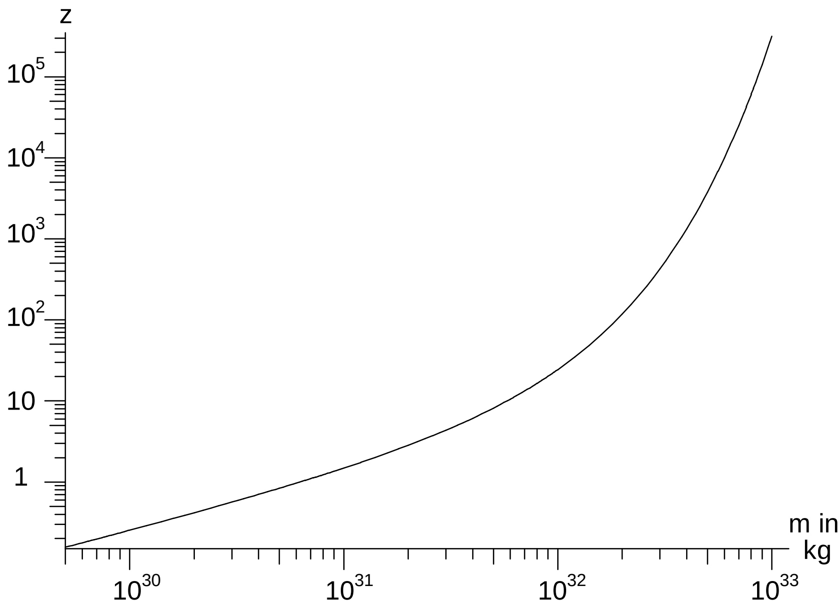
Picture 12 : dependence of red shift z from normalized distance r/R_S to the mass N=new curve C=classic curve not by the equations that describe these fields. Gravitational potential energy is always limited ! Also with theoretical point-like masses !

Also energy (electromagnetic waves) is (a very little bit) heavy and inert. These waves have also a mass and some gravitation. But the fact, there is no event horizon causes, it is impossible to build a stellar mass concentration (neutron star below 1000 sun masses) only with electromagnetic waves. This neutron star will emit radiation and lose this energy. Red shift is so high, it absorbs more energy than energy will be emitted if neutron star has more weight than 1000 sun masses. Very big mass concentrations (galactic nuclei) will grow (very slow) by absorption of energy. Of course much faster by absorption of mass.

The equations for description of gravitational field do not generate any singularity at correct usage of this equations. Mass varies by variation of kinetic or potential energy. Singularities in theory of relativity disappear by consideration of mass variations by potential energy. There is no event horizon and there are no black holes. There is no contradiction to theory of relativity. This is a precision of dissemination of gravitational field very near to a huge dense mass, in the manner of Einstein, without singularities. This dissemination of the gravitational field near a mass could never been tested yet.

Red shift and visibility inside of Schwarzschild radius is a possibility for testing this dissemination of gravitational field. You will see, if you will look on very heavy dense masses (former black holes), not so heavy very dense masses (former stellar black holes) are not black. They are emitting radiation. This is shown in picture 13. In picture 13 is shown the dependence of red shift on the surface of a sphere with a density of 10^{18} kg/m^3 on mass of this sphere.

Very heavy masses (for instance Sagittarius A*) are black only because of their giant red shift. But these objects emit also radiation up to two decades inside of Schwarzschild radius. You can see, it is possible to test this script at such objects. But you need a very high angle solution at observation of such objects. I hope, necessary solution will be possible, if fields of radio telescopes join together (ALMA and others).



Picture 13 : dependence of red shift z on the surface of a sphere on the mass of the sphere in kg with a density of 10^{18} kg/m^3

There are also additional possibilities to test this new dissemination of gravitational field near a very heavy mass, for instance with the cosmologic red shift including intensified red shift. An explanation for cosmologic red shift including accelerated expansion (dark energy) only with theory of general relativity is demonstrated in [4]. This in [4] explained solution for cosmologic red shift is based on the here described new dissemination of gravitational field, near and inside Schwarzschild radius and on equation (2.9). This solution for cosmologic red shift needs only an essential static universe with constant density, theory of general relativity, without any (expansion) movement. This is also a real Einstein manner solution. And it is possible to derive and calculate cosmologic red shift, including intensified cosmologic red shift (accelerated expansion, dark energy), without any expansion movement also without speculative not explicable dark energy.

4. Literature

I recommend some literature for presupposing facts and for extended studies :

[1] Albert Einstein, Über die spezielle und die allgemeine Relativitätstheorie, Verlag Vieweg & Sohn Neuauflage Springer Verlag

[2] H.Hemme, Die Relativitätstheorie, Einstein mal einfach, Anaconda Verlag GmbH

[3] Jürgen Altenbrunn, Eine kurze Geschichte der Zeit, Teil 2, oder über die Natur von Zeit und Raum, Selbstverlag (PDF from internet, www.altenbrunn.de/wissen.htm)

[4] Jürgen Altenbrunn, Die kosmologische Rotverschiebung als Folge der Allgemeinen Relativitätstheorie, Selbstverlag, also available in English (PDF from internet, www.altenbrunn.de/wissen.htm)

[5] Paul Marmet, Die natürliche Längenkontraktion infolge der Schwerkraft, Übersetzung von Mathias Hüfner, also available in English (PDF from internet)

[6] Andreas Müller, Lexikon der Astrophysik, aus dem Wissensportal Astrophysik (PDF from internet)

[7] Andreas Müller, Schwarze Löcher, das dunkelste Geheimnis der Gravitation (PDF from internet)

German language is used in literature. May be, some documents are also available in English language ([1],[4],[5]). The discovered facts are of course not yet in literature. There are black holes, event horizons, cosmic censors etc. in most of the documents in literature ([1],[2],[6],[7]).

The original document is in German language "Die Ralativitäts-theorie ohne Singularitäten". This is the translation. I made it myself. Please excuse me; my native language is not English. May be, it sounds not really perfect. And may be, there are some mistakes in writing. Please send me a mail with the correction, if you will find a mstake.